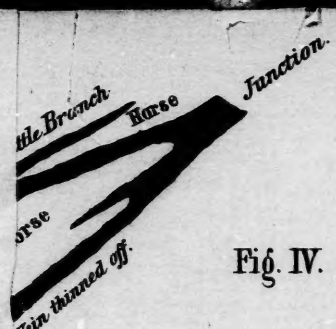


Fig. IV.

P. S. Duval's, Steam Lith. Press. Phil.ª

# Supreme Court, Halifax, N. S.

ABRAHAM GESNER

*vs.*

HALIFAX GAS-LIGHT COMPANY.

## DEPOSITION OF RICHARD C. TAYLOR,

RESPECTING THE ASPHALTUM MINE AT HILLSBOROUGH,

IN THE COUNTY OF ALBERT AND PROVINCE OF NEW BRUNSWICK.

**Illustrated by a Map and Diagrams.**

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PHILADELPHIA:
KING & BAIRD, PRINTERS, No. 9 SANSOM STREET.
1851.

# Reconnoissance Map and Diagrams of the Asphaltum Mine of Frederick's Brook,

in the Parish of Hillsborough and County of Albert in the Province of New Brunswick: from recent observations by

*Richard C. Taylor,* Philadelphia U.S.
*James Robb,* Fredericton N.B.

**A.**

*Dorchester, May 29th 1851.*

Fig. 1.

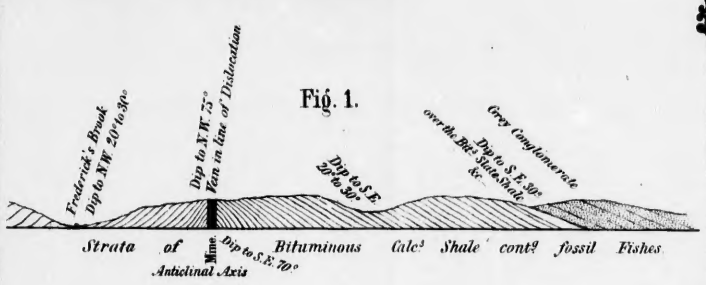


Fig. II.




Fig. III.


Fig. IV.




P.S. Duval's Steam Lith. Press. Phil.a

SUPREME COURT. } *Cause.* ABRAHAM GESNER, *Plaintiff*,
HALIFAX, N. S. } *vs.* HALIFAX GAS-LIGHT CO., *Defendants.*

The deposition of Richard C. Taylor, at present of Halifax, Esquire, a witness about to leave the Province, taken *de bene esse*, and to be used as evidence in the above cause, on the part of the plaintiff, before J. W. Nutting, Commissioner, &c., at Halifax, this 14th day of June, 1851.

Mr. Johnston and Mr. Jas. Johnston attending for Plaintiff; Mr. A. M. Uniacke and Mr. Fairbanks, Q. C., for Defendants.

The said Richard C. Taylor, having been first duly sworn, deposes and says, "My profession is that of a geological and mining engineer. I have pursued it in the United States since my arrival there, 21 years ago, and previously in England and Wales. I have written several treatises on the science of practical geology. One of my works has been particularly on the subject of coal. It is entitled the "Statistics of Coal." It was published in Philadelphia. It treats generally of the subject of coal, and kindred substances wherever information could be obtained throughout the world. I have visited the principal coal districts of the United States, and have reported to the parties concerned—associations, societies, or companies, and individuals, by whom I have been consulted in a vast number of cases. These visits, and my previous experience on the subject, prepared me to give opinions respecting it. I have been employed professionally in the Island of Cuba to examine asphaltum. I have been consulted in reference to other cases in Central America, and the Isthmus of Panama. I have been on the Atlantic side of the

Isthmus at several points; I made the first examination in Cuba for a Spanish company; I was required to examine as to the quality of the chapapote there existing, and to advise as to the best mode of working or mining it. I was not very long engaged there; sufficient time, however, to visit the locality and to make maps and diagrams and reports of the veins; I made a thorough geological mining survey. The substance I found there was pure asphaltum, called by the Spaniards *chapapote.* I had an opportunity of carefully examining the substance, and its position and peculiarities.

I have recently been employed to examine the mine at the Frederick's Brook, a branch, as I understood, of Weldon Brook, in Hillsborough, Albert county, in the province of New Brunswick; I have been there, or in the vicinity, for two or three weeks. I was there from 24th of May to the 11th of June inst. I made the visit, as I understand, at the instance of Dr. Gesner and his friends. Professor James Robb, M.D. of Fredericton College assisted me, as did other parties occasionally. Dr. Jackson of Boston was with me, a part of the time. He attended, as I understood, in behalf of parties opposing Dr. Gesner's claim in New Brunswick. We all went to the mine together; viz. Prof. Robb, Dr. Jackson and myself; consulting together on various matters that occurred in reference to the mine. The mine, which we conjointly examined, is the one in dispute between Dr. Gesner and the parties working it in N. B., under lease. We all went together; Mr. Cairns the resident general manager or agent; Mr. Brown the manager of

the mining operations; Mr. Wright a proprietor, as I was informed; Mr. Cook an agent from New York, and some others. These were the principal parties who travelled together to the mine, and who invited me to inspect it. It is the same as is in dispute between Dr. Gesner and others, and Cairns and others. Dr. Robb accompanied me during the survey, to all material points, until the examination of the vein was closed. He and I made a careful and thorough exploration and investigation of the spot. We made a map and several diagrams of details; we also made three or four copies of the same, to illustrate the position and inclination of the vein, and of the surrounding country or strata.

The plan now produced [marked **A**] is one of those we made. We found a vertical vein which was filled with a mineral substance which I at once recognized as asphaltum, and I consequently consider it as such.

The plan, now exhibited, is signed conjointly by Prof. Robb and myself.

[Question.—Did Prof. Robb agree with you in considering the substance asphaltum? He did.]

Dr. Robb and I made a joint report, to which we affixed our signatures, in like manner as to the map **A**. The paper now produced, [marked **B**] is that report.

[The reception of the Report is objected to by the Defendants.]

The result of our joint report was that the substance was asphaltum. We found the vein was placed vertically in the ground. Its thickness varies from a few inches, near the surface, to about fourteen feet in thickness at the lower position that is worked.

The two sides of the vein were not conformable to, or parallel with each other, for the most part of the length heretofore excavated; we could tell nothing beyond, at the lowest level. It was found that the inclinations of the strata, on each side of the vein, were dipping in contrary directions. All these circumstances are marked upon the map produced, from admeasurements made conjointly by Profs. Robb and Jackson and myself. We all took the measurements together; mutually agreeing upon them, before we entered them in our respective note books.

The inclination and strike or direction of the vein and adjoining strata, are ascertained from these admeasurements and instrumental observations, thus conjointly made and mutually concurred in by Profs. Robb, Jackson and myself. The same remark applies to the breadths of the vein at different points, and to the general features of the bounding strata.

I doubt the propriety of designating them as walls. The bounding strata frequently diverge and converge, so as to make the vein thicker or thinner, as the case might be, at certain intervals and positions. We found the general course of the mineral vein to be about N. N. E. and S. S. W. It did not pursue an exactly straight line, but varied a few degrees in its course, as shown on the plan **A**. The meaning of the term *strike* is the course or general range of the stratified masses, shales, or bounding strata, on either side the central vein. The *dip* is the inclination of same strata from a horizontal line.

The strike of the adjoining strata in this instance, is not uniformly parallel with the sides of the vein;

this is one of the most characteristic features presented. All these facts are exhibited upon the plan, and are noted in the Report. *Conformable* means where two sides of a seam, whether of sandstone, coal, or shale, are strictly parallel with each other; we found that this Hillsborough vein was *unconformable*. It corresponded very closely with the asphaltum or *chapapote* veins in the Island of Cuba, which I have examined and reported upon. The material of the vein came more frequently in contact with the broken edges of the upturned strata, especially those on the N. E. side of the vein, than did any strata which conformed to the general line and to the supposed walls of the vein itself. Therefore, in that respect, the two opposite sides or margins of the asphaltum vein, were very dissimilar at certain points, yet for short distances were parallel and conformable; on the one side, they were seen in contact with the *broken edges*, and on the other with the *planes* of the rocks contiguous. One instance out of many is described in fig. 3.

I observed that the vein of asphalte occurs in the midst of a district composed of bituminous, calcareous, or marly shale, in which fossil fishes abound. I do not consider it has either a true roof or floor, in mining phraseology. It has no overlying nor underlying *fire-clay*. It has no overlying nor underlying conglomerate; it exhibits no coal plants, as is usual in the immediate vicinity of coal seams; unless one or two fragments, of doubtful appearance and accidental presence, might constitute the exception. It possesses no parallel, conformable *lamination*, horizontally, as in coal and coal seams, which are conformably deposited

in the carboniferous system. Instead of this, the divisional planes are arranged *transversly; i. e.*, at right angles to its sides; as also is the case of the asphaltum or chapapote veins of Cuba.

I am unreservedly of opinion that this Hillsborough vein of asphalte occupies a *line of dislocation;* somewhat in the manner of a steep and narrow anticlinal axis—wedging or coming to a point upwards. By the direction of the force which was exerted, both longitudinally and laterally, the bordering shales were tilted or thrown down in opposite directions to either side, for a considerable area; their inclination being reduced or flattened as the distance increases from the central line of fracture.

Stigmaria is one of the most prevalent coal plants. The stigmaria, calamites, ferns, sigillaria, lepidodendrons, lycopodium, and various other fossil vegetables, are characteristic of true coal seams. Not one of these genera were seen by me in or near the asphaltum vein, of New Brunswick; nor in the bituminous surrounding shales. I could trace no fossil vegetation therein, whether of terrestrial, of marine, or of freshwater origin.

I perceived in the mine that there were several lateral ramifications from the main asphaltic vein. One of the most characteristic of these I have endeavored to delineate in Fig. 4 map **A**. It here shows a separation, a branching off and departure from the main vein, a portion of which holds on the original course, although contracted to about 10 inches in width or thickness. The ramifying vein, now become the principal one, after branching off from the main

or parent vein, is seen to pass off at a considerable angle, receiving and giving off, in its course, several smaller veins.

Thence, after again subdividing, the principal part of the vein, so ramified, reunites with the other branches, and rejoins its original stem; where the working along the original course is resumed. This is seen in a place locally called the Jog; and it may be added that the excavation of the asphalte is conducted in this lateral branch, as the working of the original vein is, for a space too contracted to be worked to profit.

The lower levels have not been pushed so far to N. E. as to reach this point. In the number IV. level it was followed round. But in Fig. 2, representing part of level No. VIII. the map does not exhibit the feature just described for the reasons stated.

In this mine of Hillsborough a shaft is sunk, some 40 or 50 feet deep; and from it four levels or galleries of excavation are conducted from N. to S.—on each side, and towards each extremity; numbered from 1 to 8. The plan **A** exhibits levels No. 7 and No. 8; which, in reality, are on one uniform level. The gallery immediately above is designated as Nos. 5 and 6—the one above that as 3 and 4; and the one above that as Nos. 1 and 2. The even numbers designate the galleries on the N. E. side of the shaft; and the odd numbers the levels on the S. W. side of the shaft. The ground plan **A** exhibited, shows by the black extremities how far the vein has been worked on that level—viz., on the galleries No. 7 and 8, the black extremity represents the unworked asphaltum. All

these levels, when in operation, are furnished with a temporary floor of timber and cross ties, and have wooden tram-ways laid thereon, for the purpose of bringing the asphaltum to the shaft in wagons.

What is called by miners a "*Horse*" is a worthless mass of slate or other profitless material, which may happen to intervene and consequently to stop the working of the vein in that direction.

Examination adjourned till Monday morning, 16th inst., at 10 o'clock.

*June* 16*th*, 1851.

*Mr. Taylor's examination resumed.*

The substance called asphaltum occupied a fissure or line of dislocation, and an *anticlinal axis*, which tilted off the strata in opposite directions from its sides; and which fissure has been subsequently occupied by the injected asphaltum while in a liquid state. This latter fact of itself forms a striking contrast with a seam of coal, which under no circumstances has ever been seen in such a position. The Hillsborough asphaltum, I feel assured, was posterior to the shale in which it occurs, and in which it obtrudes itself. In other words, the asphaltum and the surrounding bituminous shales which abound in fossil fishes, are decidedly *not of contemporaneous origin*. The asphaltum which filled the fissure or line of fracture, was originally a mass injected from the depths below, in a liquid or fused state, therein; which fissure was of course caused by a disturbing force operating on the crust of the earth; a case of by no means uncommon occurrence. The position of the vein between the strata,

as well as the internal arrangements of the vein itself, are analogous to veins of asphalte elsewhere, and are by no means analogous to coal seams. In my judgment I considered that the material which fills this vein is true asphaltum, and that "it is not coal nor any variety of coal."

Asphaltum and coal are two very different substances. They differ in all respects, as we learn from chemical as well as geological investigation, as also from their adaptation to useful purposes. The circumstances, discoverable upon the survey of this vein, which lead me to the conclusion that its contents are asphaltum and not coal, are principally the following, viz:

That whereas the true coal seams are disposed in uniformity and parallel with the surrounding or containing strata, and continue longitudinally and in uniform thickness through veins for considerable distances, veins of asphaltum appear to occupy, adventitiously lines of fracture, and are seen to ramify into smaller veins which traverse in irregular directions, unconformably with each other, any adjoining rocks, whatever may be their age.

That the contents of a coal seam are subdivided longitudinally, viz: in the *longitudinal direction* of the seam, and thereby mark the line of accumulation, or the planes of deposit, in contradistinction to asphaltic veins, which present no parallel lamina, but whose divisional planes are placed transversally, viz: at *right angles* to the sides or walls of the veins.

And whereas the matter of true coal seams is *wholly of contemporaneous origin*, geologically speaking, with

the contiguous strata, veins of asphaltum on the contrary, are always *posterior* to the surrounding strata.

Asphaltum is mineral matter *injected* into an open fissure. Coal is obviously derived from vegetable materials; of plants which have grown and have died upon the spot and have thus *slowly accumulated.*

As already stated, I have no doubt the asphaltum, now in question, was an injected mass. Dr. Jackson, conforming to that opinion, formed by Prof. Robb and myself, fully agreed in that view—viz: that it was an *injected vein.* If we were right in that judgment, the material certainly could not be a seam of coal. It could not be coal at all.

By the term "anticlinal axis" is meant the upheaving and throwing off laterally, masses of strata in opposite directions, more or less inclined from the perpendicular. The cause is ascribable to a powerful force which was apparently exerted from below. When such a disturbance has taken place, in localities where coal exists, the seam of coal, together with the overlying and underlying strata, preserve their relations to each other; and although dislocated, maintain their parallelism to one another, whatever may be the inclination, or the departure from their original horizontality.

Coal, from the nature of its formation from vegetable matter, and from the adjoining beds which abound in organic forms, such as shells and fishes, which formerly occupied the contiguous waters, furnish the direct evidence that such strata were originally deposited or existed horizontally.

The opposite of this is asphaltum veins, which are

influenced by no such circumstances. The sketch now produced, [marked **C**] figure 1, presents the ordinary features of a horizontal coal-field. The diagram on this sketch, [marked fig. 2.] shows a portion of a coal field which has been thrown off from its original horizontality. Fig. 3, shows a coal *fault* or *heave*, where, owing to some lateral violence, the coal seam has been broken and thrown out of its original continuity. Here each portion still preserves its relative parallelism with the accompanying stratification.

The diagram No. 4, shows the ramifications of an asphaltum vein, such as we have observed in Cuba and at New Brunswick. The sketch marked **D**, represents vertical sections of those asphaltum veins, at those places.

In the case of asphalte, the divisional planes run transverse, or about at right angles to the walls of the vein. These *planes of division* are judged to have been formed during the process of cooling, contraction, and consolidation of the material.

In the case of a coal seam the *planes of deposition* run parallel with the seam itself. In this characteristic a vein of asphaltum and a seam of coal are entirely opposite to each other. The sketch now produced, [marked **E**, and also Fig. 1 in map **A**] exhibits a rough transverse section of the asphaltum vein at Hillsborough, and of the bituminous strata on both sides, rising from below the gray conglomerate on the south-east, and exhibiting the reversed inclination of the strata on either side of the fissure which formed the anticlinal axis. It shows these strata dipping in opposite directions, and exemplifies the line

of fracture which has been subsequently filled with asphalte or the material now constituting the mineral vein.

Independent of any chemical questions or opinions, the following facts, exhibited at the New Brunswick mine, are physical characteristics of a true *asphaltum* vein.

1. The absence of lamination in the mass.
2. Its brilliant conchoidal fracture and occasional tendency to assume a columnar structure.
3. The character and configuration of its surface markings.
4. Its small specific gravity; not equalling nor exceeding many of the resins.
5. The general prevailing uniformity in the entire substance or contents of the vein.
6. Its aspect, fracture, divisions, purity, and especially its almost entire freedom from foreign and earthy matters.
7. The absence of all vegetable traces in connection with the material of the vein.
8. The absence of all apparent organization in its composition.
9. Its apparent fused and liquid state originally, and its subsequent consolidation after cooling.
10. The practicable restoration of its characteristic surface markings, and its peculiar conchoidal fracture, after being once more melted and rendered soluble, and again cooled and consolidated.
11. Its not soiling the fingers, in the manner of coal.
12. Its being strongly electric.

The physical characteristic marks of *coal*, in contradistinction, are for the most part as follows, viz:

1. The lamination of its planes, which show the lines of deposit and develop the progress and mode of accumulation.
2. The rhomboidal subdivision and separation which almost all the unaltered bituminous coal seams exhibit.
3. Its irregular or indefinite cross fracture.
4. Its striated lines of horizontal deposition, as shown equally on all the sides of any portion of the mass.
5. The variable appearance presented by these strata, passing from dull, slaty lines or stripes to others which exhibit a highly brilliant, jet-like lustre, according to the greater or lesser amount of earthy impurities which prevailed at the respective periods of their deposition.
6. Its greater specific gravity; as influenced by the presence or absence of earthy matter.
7. The abundant accompanying traces of its vegetable origin.
8. The occasional presence of other organic forms, in close contiguity.
9. The impossibility to effect a solution of coal in manner of asphalte.
10. Whereas coal in a modified state, such for instance as anthracite, may still exhibit distinct traces of its original laminations of growth by means of the ashes which it leaves after combustion, the original aspect of its fracture, after fusion, can never be again restored, as has been shown to be practicable in relation to asphaltum.

11. The bituminous odor of coal is obscured by the quantity of foreign and impure matter contained, whereas, the odor of asphalte is resinous, approaching to the scent of *amber*.
12. Asphaltum, like amber, is *electric*, while coalis not.

The material of the vein at Hillsborough, corresponded, in all important characteristics, with those of asphaltum just enumerated, and contained none of the characteristics of coal. I saw a boat, belonging to Mr. Edgetts, on which a substance had just been applied for the purpose of graving it, and I saw the iron kettle which yet contained the residue of that substance which had been so employed. It had the appearance of solid bitumen or pitch which had been recently melted and subsequently cooled and hardened. It was then in a solid or compact state, and was evidently part of the substance which had been employed in paying the boat. When broken, its fracture exhibited similar characters to those of the asphaltum of the vein, from which it had been prepared. Dr. Robb and I handed a piece, that we took from the kettle, to Dr. Jackson. There is no variety of coal that is capable of similar solution and of application to like purposes, and of subsequent restoration to its original aspect when cooled.

The specimen of asphaltum, now exhibited, marked **N**, is a piece taken from the Hillsborough vein. The other specimen, now produced and marked **F**, is also asphalte, and is apparently derived from the chapapote mines of Cuba. I do not positively know its locality, but I have seen a simliar article in the Island

of Cuba. There are slight modifications in the structure, aspect, and color of asphaltum, as there are in coal. The piece now shown to me, marked with a Broad Arrow, (↑) is in all respects similar to that substance which I found at Hillsborough, and I should say that it came from thence, but as I did not bring it here myself, I cannot positively swear to it, although I have no doubt of it.

The specimen, marked **C**, now exhibited, is *Petroleum*, a mineral pitch in a soft state. I found it at Ayres's Farm, on the eastern side of the Petit-codiac River, apparently in range with the bituminous shales of Hillsborough. Petroleum is usually found in the neighborhood of asphaltum. As I have already stated, I have found the Hillsborough asphalte to correspond with that of Cuba. The specimen now produced, marked **H**, is bituminous coal, showing the parallel lines of deposite which were occasioned by the alternations of pure coal with that of inferior quality, and even with earthy matter and slate. It also exhibits, externally, a fibrous, vegetable structure, assimilating to charred wood or charcoal.

Judging from all the geological and physical characters already detailed, I consider that the mineral substance found by me in the Hillsborough mine, "is asphaltum, and not coal or any variety of coal."

*Cross-examined by Mr. Fairbanks.*

I do not profess myself to be a practical chemist. My opinion, as respects the matters in question, in this suit, is mainly founded upon my experience as a geologist, and not derived from its chemical analysis,

solely. I am not a professional chemist; and in my various business reports, whenever the substances treated of in them required chemical investigation, I have placed them before a practical chemist of approved reputation.

I think it is not less than sixteen years since I was investigating the asphalte of Cuba. At that period the article was commonly designated as *chapapote*. The Spaniards, when addressing those who only spoke English, always made use of the term *coal*, although there is no true coal in the Island. Being little familiar with that combustible, and having never seen it in position, it was quite to be expected that, on finding a black, inflammable substance in the earth, they would call it coal. This chapapote presented itself in the form of a decided vein. In one locality it would be more compact, perhaps, than at another, some miles off. The *Casualidad* mine was then worked entirely as an open excavation or pit, about thirty feet deep and forty feet square. I was thus enabled to see that the mineral existed in a solid, continuous form, having branching veins, both laterally and longitudinally. Petroleum and naphtha existed in the vicinity. In fact, the naphtha springs abounded in the direction of Havana and especially near Guanabacoa, a city greatly resorted to by invalids, to drink those waters medicinally. The Casualidad vein and its various ramifications, passed across various rocks and slates, which exhibited traces of liquid pitch and naphtha, occupying cells and cavities therein. In this respect, they may be locally classed as bituminous rocks. In New Brunswick, bitumen appears to be diffused through, or contempo-

raneous with, the calcareous, fish-enclosing, shales. In Cuba, it appeared to me to be somewhat more concentrated and to flow out in greater quantities.

I presume that naphtha is bitumen in its most liquid or perhaps diluted form; that petroleum is mineral pitch in a state of flexibility and partial solidity; and that asphalte is the same substance in its most compact or solidified form. All three appear to be derived from a common source within the earth. I decline to give any opinion in relation to their origin. I perceive that chemists differ entirely on this point. I consider that asphaltum is a *combustible mineral*, and in the state of pure bitumen. *Coal* consists of vegetable matters which have been bituminized. *Asphalte* is composed of carbon and hydrogen, principally: it also contains oxygen and nitrogen. At present I have not melted asphaltum on a large scale, but only as I would sealing wax, by holding pieces to a lamp or candle. The specific gravities of the New Brunswick and Cuba asphaltes, recently determined in Philadelphia, by myself chiefly, are as follows:

| | |
|---|---|
| That of Casualidad Mine,—mean of 3 observations, R. C. T. . . . | 1.176 |
| That of a mine near Matanzas, mean of 2 observations, T. . . . . | 1.160 |
| That of the mine at Hillsborough, New Brunswick, 1st observation, T. . | 1.095 |
| do. 2d do. T. . | 1.096 |
| do. 3d do. Buck. . | 1.097 |
| In Glasgow by Prof. Penny . | 1.097 |

Asphalte emits an agreeable scent like amber, when rubbed, both in the specimens derived from

Cuba and from N. Brunswick. They give out smoke when under combustion, especially that in Cuba, emits a large volume of densely black smoke. It was considered, in a joint report made by me and Mr. Clemson at the time of our survey there, that its best adaptations were for the making of Lamp-black and the manufacture of Gas.

I see no connecting link between asphalte and *cannel coal.* The latter often forms a portion of a regular bituminous coal seam; occupying sometimes the upper part of the stratum, sometimes the lower, and occasionally forms the central portion. Such, for instance, where the cannel coal occurs in Missouri, Indiana, Kentucky, Western Virginia, Mississippi, and other states, and at various localities in Europe.

I know that fossil fishes occur in coal shales, clay, and slates in the United States and in Europe; particularly in Scotland, France and Germany. They also appear abundantly both in the coal shales of Nova Scotia and in the calcareous bituminous slates of Hillsborough, New Brunswick. At the present moment I cannot recite the names of those fishes. This branch of science is comparatively new, and has been hitherto fortunately confided to its most successful investigator, Professor Agassiz. I am well aware that a certain class of fossil fishes are also not unfrequently contained in some members of the Old Red Sandstone formation.

I cannot say that I have observed in the shales of Hillsborough any fossil plants. Vegetable remains invariably accompany coal, and coal shales, and fire clay. Fishes are comparatively rare, but yet by no

means of uncommon occurrence. I can mention two localities in the coal fields of the United States, where fossil fishes abound in the shales. One is in Virginia, the other in North Carolina. Coal formations originate in *terrestrial* vegetation: but the adjacent shales often contain *marine* and *fresh* water shells. The more recent coal beds, such as the *tertiary* and *brown coals*, occasionally are accompanied by *animal* remains. In the true coal formation, little or no evidence exists of the presence of this animal matter to an appreciable extent. There is evidence of the presence of animal matter in the Hillsborough bituminous shales, in the fishes which abound therein.

I certainly entertain the opinion that the asphalte vein of Hillsborough was protruded from below. I perceive unquestionable evidence that such was the fact, and I consequently infer therefrom, that it could not possibly be a coal seam. The calcareous, fish-containing, bituminous shales, through which this asphalte vein was protruded, are seen to pass, on the south, beneath gray and red conglomerates, grits, marls and sandstones. This series, according to the limited attention I had time to bestow on them, appeared to occupy the position which is usually assigned to the Old Red Sandstone group. This group is situated beneath the coal formation, which approaches within a few miles of the Hillsborough Mine.

The Hillsborough shales do not appear to have been affected or altered by igneous agency or subterranean heat; except slightly in the contortion of the shale at a very few points. I see, on the contrary,

that the rocks upon which some of these bituminous shales repose, are all more or less modified by metamorphic agency. Those occur on the slopes of the Caledonia mountain; seams of bituminous coal were not observed near the mine, but at a few miles to the south of it. Coal plants are abundantly prevalent in the gray and red grit and sandstone, alternating with thin seams of coal and beds of *fire clay*, both at the north and south Joggins.

Every coal field exists under the same geological relations with regard to the associated rocks. The more modern coal beds, as I before remarked, are associated with a later class of rocks than those of the true coal formation. Disruptions of the strata by which changes in position and dip, and local continuity, have been effected, are incidental to every coal seam whatever may be its geological age. But the older coal series have evidently been subjected to more violent disturbing agencies than those of later periods. These ancient formations, as now existing, bear testimony to the frequent and powerful influences that have been exerted within their respective areas, and which have occasioned those extensive dislocations, those faults and heaves, and those numerous changes of axis, which certain coal regions present. For instance, the anthracite districts of Pennsylvania. With occasional exceptions, the more recent coal deposites retain more of their original horizontality. Coal never traverses the contiguous strata, but continues parallel to it.

I have not had an opportunity to ascertain whether the supposed old red sandstone of Albert county

contains marine shells. My researches were by no means directed to such details, and I considered that they were not strictly essential to an investigation of the Hillsborough asphalte.

Examination adjourned till to-morrow morning, at 10 o'clock.

*June* 17, 1851.

*Cross-examination of Mr. Taylor resumed.*

My impression was that the red and gray rocks of Hillsborough, occupied a position analagous to that of the old red sandstone in other parts of the world, but that is a point upon which, with my present limited knowledge, I by no means desire to insist. I had no opportunity of investigating the relative position of the gypsum of Albert county and the red series and calcareous strata to which allusion has been made. I saw, however, as I previously stated, that these calcareous bituminous strata were lower than the red and gray rocks; having evidence of that in more than one instance.

Coal is not uniform in its proportions of bitumen. Very few coal seams, and even parts of the same seam, contain on investigation precisely the same specific proportions of volatile matter. I presume that the question of the bituminous matter contained in coal has been thoroughly and sufficiently investigated; but science is every where progressive, and some future investigators may yet throw additional and valuable light upon this. For myself, I am not prepared to speak upon the subject. The amount of volatile matter in bituminous coal, may be said to vary from five to fifty per cent.

Asphalte I know to be readily soluble in naphtha and also in coal tar. I have witnessed the process on a sufficiently large scale in the Hillsborough mineral. The solution was complete and occupied but a short time, and when thus dissolved, could be readily poured into any vessels. To increase its fluidity for the purpose of a *paint*, linseed oil was added; and to adapt it still more to the purposes of a *varnish*, spirits of turpentine was introduced.

There are no particular rock formations which indicate, or are specifically peculiar to, asphaltum veins. Such veins are in no way connected with the strata which they traverse, in relation to their geological age. I am not aware that asphaltum exists in coal mines, either in seams or masses. Bitumen, in greater or less abundance, occupies the ancient vegetation of coal seams, in lamina, which attest the progress of accumulation and periodical deposition.

I do not consider it as a fully determined geological fact that the rocks at Edgett's Cape, appertain either to the coal formation or to the upper members of the old red sandstone. Unless considerable time were devoted to the examination of that part of the coast, it would be difficult to define the exact line where one group of rocks begins and the other ends; the passage from one series to the other being so gradual. Moreover, the establishment of the fact, however interesting it might be in elucidating the general or local geology, does not appear to have an immediate or material bearing upon the asphaltum question at issue.

I have previously explained the position of the fossil fishes in the bituminous shales of this part of

the country, and the more recent origin of the asphaltum vein therein. Similar fishes occur in the same description of shales, on the east of Petit-codiac River, near to Petroleum and to Naphtha springs. Asphaltum appears in small veins, traversing fetid limestone, three miles north of Dorchester.

The clays and sand-stones of the coal formation comprise terrestrial vegetation, and occasionally beds which contain marine shells, and others which have an approach to the fresh-water or estuary shells. At the Hillsborough mine I found no fossil plants, with the exception of two doubtful specimens shown me, and mentioned in the direct examination. I examined the strata in and around the mine and saw no calamites, flag-like leaves, Lepidodendrons, or other fossil plants. Even had I done so, it would still have not amounted to a coal seam, on account of their extreme rarity.

Where the original horizontality of a coal seam has been disturbed, the shales and strata there adjacent, are tortuous and broken; although they retain their relative conformability, in great measure. Faults in coal strata frequently interrupt the continuity of the seam by the local interposition of unprofitable masses, called by miners, "*Horses*," which frequently occasion considerable trouble and expense in cutting through them. Some such difficulty is also presented in the Hillsborough mine, but from a different cause—namely, by the branching off or the bifurcating of the vein, as represented in Fig. 4, of map **A**. The bounding walls of the vein at the north end of level No. 8, on the 27th of May, just past, were observed

to be nearly parallel. Elsewhere there existed less of conformability, but I do not consider that in those cases where the ends of the highly inclined contorted slates abut against the asphaltum, they come within the denomination of "Horses." Although I have not examined the entire boundaries of this formation, I think there exists no evidence that of itself it forms a coal basin: at Frederick's brook it is the very reverse. [Fig. 1, map **A**.] The green metamorphic slates of the Caledonia Mountain, rise from beneath the series of bituminous shales. The latter, on the other hand, are covered by the gray and red conglomerate series previously adverted to. The dip of the bituminous shales was towards the north, 45°; the course east and west by compass. The metamorphic slates dipped north, 30°—at an angle of 50°—from horizontality. In the red sandstone of the neighborhood, the dip was 40° towards the north west. I had no means or occasion to verify the connection between the bituminous shales seen at the foot of the Caledonia Mountain and those at the mine; there being no topographical map of this region extant.

I derive my opinion of the Hillsborough asphaltum chiefly from the geological phenomena attending it, as before stated in detail, and from the facts elicited in effecting its solution and its applicability to the purposes of paint, varnish, &c. I believe that no coal seams have ever been in a state of liquefaction or in the form of veins. I am fully convinced that the Hillsborough asphalte is *an intrusive substance:* in other words *a vein of injection,* of later origin than the enclosing rocks, precisely as is seen in the chapa-

pote of Cuba. To denominate stratified rocks or substances intrusive, seems to involve a contradiction of terms. I saw no trap or igneous rock in the immediate vicinity. The nearest approach to such was in the metamorphic slate spoken of.

Coal can almost always be identified by its external characters. It consists of bituminized plants. Anthracite is coal deprived of its bitumen by a moderate application of heat. Cannel coal appears also under much the same circumstances as other varieties of coal. Being more compact, the lamination of its planes is not so readily distinguishable; and this solidity probably induces the large characteristic conchoidal fracture. (Specimen produced, marked **I.**)

The asphaltum of Hillsborough, is said to acquire weight as it descends. I selected specimens from the mine with a view to determine that point, but have not yet had an opportunity to prove their relative specific gravities.

Coal generally contains Carbon, Hydrogen, Nitrogen, and Oxygen; being similar elements, though not in the same relative proportions, as exist in asphalte. The same elements enter into the composition of vegetable and animal matter also, otherwise remarkably different. The matter of asphaltum, in such positions as I have been enabled to examine it satisfactorily, has always conveyed the impression that it was derived from very deeply seated sources in the interior of the earth. Respecting the origin of this substance, I perceive that scientific men, geologists as well as chemists, vary much in their speculative views thereon. It is a point by no means

settled, nor do I think that any prudent man would venture positively to assert as to what cause is its origin ascribable.

Dr. Robb, Dr. Jackson and I, had no difficulty in agreeing upon the principal facts exhibited in the mine itself, but Dr. Jackson apparently desired to reserve his inferences for the present. The latter gentleman is a chemist and is employed in geological surveys.

Every coal seam possesses a roof and floor, the latter being full of vegetable traces. I saw nothing at Hillsborough to justify the employment of these terms, roof and floor. The term walls might be used with more propriety. There is no apparent connection between the material of the vein and that of the slates which border it, and through which it has been thrust. The mode in which the asphaltum filled up all the irregular angles of the broken edges of the disturbed slates, is shown in the diagram Fig. III. in map **A**, and in the enlarged separate diagram, marked **Z**.

Cross-examination adjourned till to-morrow, at 10 o'clock, A. M.

*June* 18, 1851.

*Cross-examination of Mr. Taylor resumed.*

All the maps and diagrams here produced are made by myself, and with the exception of the map **A**, which was made in Dorchester, New Brunswick, were sketched in Court during the progress of the present examination. Map **A** was constructed from admeasurements taken in the mine.

Coal plants, as might be expected, vary in species

and number in different localities. The small obscure fragments shown to me as coming from the bituminous shales near the Hillsborough Mine, may be the remains of some marine plants upon which the fishes might be supposed to feed or to search for food. Being carniverous fishes, however, as we have abundant evidence in the coprolites or fossilized fœces, which contain scales, vertebra and other bony fragments, marine plants, as in other cases, might not have been essential to their existence.

There was shown to me at one point, in the lower level of the mine, a slight stream of gas, called a "*blower*," which issued from a small fracture of the south-west wall. This blower, on the application of a lighted match, gave a slight flash, in the manner of an electric spark, and seemed to correspond with the nature of fire-damp.

Veins of asphaltum are of great rarity. With the exception of the Hillsborough vein, I am not aware of any upon this continent. It differs here from that of Cuba, only in the rock formations adjacent. In Cuba they are chiefly in a metamorphic state; and the same agency no doubt gave rise to the intrusion of the asphalte. I neither saw nor heard of any tendency to fire-damp there. The differences between the asphalte of Cuba and that of Hillsborough, are very slight and immaterial; but some varieties are more open or porous than others, probably owing to the escape or extrication of a greater amount of gas in the latter case, while under the process of cooling, particularly near the upper portion of the vein.

A specimen of asphalte from the Dead Sea, shows

a compactness, brilliancy, and intensity of black color, that even rivals that in Albert county, New Brunswick.

*Cross-examined by Mr. James Johnson.*

I went to Hillsborough for the sole purpose of examining the mine, and my attention was only incidentally called to the other formations of the neighborhood. All coal fields are geologically situated above or higher than the old red sandstone groupe. I know of no instance where petroleum is found in the vicinity of a coal seam. There is frequently an apparent oily matter floating upon waters discharged from coal strata, and forming a sort of film or pellicle. In this case, however, it has been ascertained not to be naphtha, but originating from a different cause.

*Jet* is bituminized wood of the most recent series of formations, chiefly the tertiary. Yet this substance has sometimes been confounded with coal. If two substances are found to contain the same ingredients or constituents, which are common to both, although in different proportions, I should not therefore feel justified in considering them to be one and the same. We often find very different substances which contain similar constituents, yet nevertheless they are by no means identical. Supposing coal and asphalte to to contain the same common ingredients, but in very different relative proportions, it would not authorize me to call bituminous coal by the name of asphaltum, nor to denominate asphaltum as true bituminous coal.

I have endeavored to point out, during this examination, the many essential differences between them.

I have seen the Albert county asphaltum dissolved, in one experiment with *naphtha* alone, and in another through the agency of *coal tar*. I saw the two specimens now produced [each marked **K**] melted. Part of the product was employed to paint or varnish on wood, and the remainder was poured into vessels while in a fluid or boiling state. I was desirous of showing also the restoration, after cooling and consolidation, of the peculiar conchoidal fracture and markings. The vessels, which contained the cooled substance, were subsequently broken by me. I retained portions of their contents to exhibit on this occasion. The fracture and marking were very similar to those seen in the Hillsborough specimens taken out of the mine. The experiment is the more interesting inasmuch as it illustrates certain points of variation in the appearance of asphaltum to which allusion has been made. For instance, in some veins of asphaltum in Cuba, where it occurs in its most compact form, and in others where it is cellular or spongy, the latter character is evidently occasioned by the escape of gas during the process of cooling. The highest part of the deposite is, in this case, porous and even spongy, while the lower part is compact, as illustrated by the specimen exhibited. [Marked **K**.]

When the melted asphalte was put upon the piece of wood, [marked **L**] now produced, it formed a varnish. I noted the paint after it was mixed with spirits of turpentine, which latter mixed very readily.

Asphaltum veins might possibly be injected and

traverse a coal field, in manner of a trap-dyke. Nevertheless, I have no immediate recollection of such a circumstance having ever occurred. If vegetables or fossil plants prevailed, *in sufficient abundance to constitute a coal seam*, at Hillsborough or elsewhere, the fact would admit of no denial, when presented to our observation. In this reply, I had reference to a particular seam or bed which might occupy a position in the vicinity of the asphaltum vein. Yet that would in no respect, affect or change my opinion as to the origin and nature of an asphaltum vein. Admitting that a coal seam might occur, even in the immediate vicinity, the circumstances which mark the origin of the asphaltum remain unchanged. I have said, more than once, that veins of asphalte cross rocks of almost every known geological age. Therefore, there would be no incongruity in vegetable and animal remains being found in the vicinity of such veins.

The gas found in coal mines is carburetted hydrogen gas,—commonly called, when evolved in mines, fire-damp. I believe that the gas I observed at Hillsborough to be the same as fire-damp. I did not analyse it.

*Re-cross-examined by Mr. Fairbanks.*

The specimen in this white pot [marked **K**] was melted with the aid of coal tar. The latter was in the greater proportion as to weight, but in bulk was about equal, so also with that dissolved in naphtha. In both cases they received the addition of spirits of turpentine, in order to make a thinner varnish. The

asphaltic odor of the produced specimen is disguised somewhat by the coal tar.

I have never tried or melted the Hillsborough asphaltum upon iron heated to 600° Fahrenheit.

[Question. "Would you pronounce a substance to be true asphaltum which would *not* melt upon the application of iron heated to 600° of Fahrenheit?" It would be a matter of surmise either way with me, as up to this time, I have performed no experiment nor seen any performed."] I am satisfied that it will melt at the temperature of boiling water, or 212 degrees, from the action of the substance while carrying on the other experiment, and that it would be totally destroyed at such a high temperature as 600 degrees. I have melted it readily as sealing wax by the heat of a lamp or taper, and I have seen it employed in sealing letters, like the ordinary sealing wax.

(*Signed*) RICHD. C. TAYLOR.

Sworn to before me
at Halifax, N. S.,
this 18th of June,
1851.

(*Signed*) J. W. NUTTING,

*Commissioner.*

SUPREME COURT. NOVA SCOTIA. } *Cause.* ABRAHAM GESNER, *Plaintiff*, *vs.* HALIFAX GAS LIGHT CO., *Defendants.*

I certify the foregoing to be a true copy of the original deposition in the above cause, filed in the Prothonotary's office of the Supreme Court at Halifax.

(*Signed*) J. W. NUTTING,
*Prothonotary Supreme Court of Nova Scotia.*

21*st June*, 1851.

NOTE.—In transcribing the foregoing deposition from the copy made in great haste at the Prothonotary's office, as I was on the point of leaving the province, it became necessary to correct many inadvertencies of orthography and punctuation, and a few slight mistakes in scientific words, ere they could appear in printed form. This I considered myself at liberty to do, particularly as in no case did these corrections involve the obvious intent and meaning of every part of the matter deposed to. In a few instances, when similar answers to precisely similar questions had been several times given, they here appear in an abridged form, without changing the sense; and with this explanation, I place the MS. in the hands of the printer.

RICHD. C. TAYLOR.

*St. John, N. B.*, 27*th June*, 1851.

JOINT GEOLOGICAL REPORT [MARKED B., AT PAGE 5 OF THE FOREGOING DEPOSITION] ON THE ASPHALTE MINE OF HILLSBOROUGH, N. B., BY RICHD. C. TAYLOR AND JAMES ROBB.

DORCHESTER, N. B., 29*th May*, 1851.

The undersigned having examined the mine at Frederick's Brook, in the Parish of Hillsborough and County of Albert, in the province of New Brunswick, found the mineral dug therein,—

1. To be placed almost vertically in the ground:
2. To vary from 1 to 14 feet in thickness, while its bounding walls diverge and converge accordingly:
3. To vary in its general course or strike:
4. To have its principal divisional planes always arranged unconformably to the bounding strata on either side—as in the case of the chapapote or asphalte of Cuba:
5. To come in contact with the edges much more frequently than with the planes of the contiguous rocks:
6. To be associated with rocks which for very considerable distances from the mine are highly impregnated with bitumen:
7. To have no proper "roof and floor," and no under clay or other subjacent bed containing *stigmaria*, or the ordinary vegetable fossil remains of the coal measures:
8. To give off several lateral ramifications, which both intersect and conform to the shale by which they are bounded:

9. To occur in bituminous, marley, [calcareous] shales, which, at the mine, are much disturbed and contorted.

From the facts above stated *we infer*,—

1. That the mineral mass is not parallel with the surrounding strata or measures, but that it cuts or intersects them:
2. That it is a true vein—occupying a line of dislocation of uncertain extent — and not a stratum conformable to the rocks in which it is contained, in the manner of coal seams:
3. That its origin is posterior to that of the shale wherein it occurs—and that it is not contemporaneous with them:
4. That the position of the vein in the rock, as well as the arrangement of the parts of the vein itself, are decidedly much more analogous to the case of asphalte in other places than to that of coal:
5. That it is asphalte, or a variety of asphalte, and not coal or a variety of coal.

(*Signed*)

RICHD. C. TAYLOR, *Philadelphia, U. S.*
JAMES ROBB, . . *Fredericton, N. B.*

REFERENCE TO MAP A.

FIG. 1. Transverse section of the Vein and the Bituminous strata, passing beneath Gray and Red conglomerates, and sandstones on the south.

The inclination of the strata toward's Frederick's Brook, is for the most part about N. 75° W. 20° (magnetic.) The vein forms an anticlinal axis, and throws the strata in opposite inclinations.

FIG. 2. Map of the Hillsborough Mine, showing Levels No. VII. and VIII., the shaft, and the directions and angles of dip on either side, as denoted by the arrows. The inclosing strata, chiefly consists of bituminous, calcareous or marley shales. They contain numerous fossilized remains of fishes, but are without the coal plants which usually accompany coal seams.

The vein does not exhibit a true roof and floor as in the case of coal seams. We are of opinion, that it occupies a line of dislocation or fracture, in manner of an anticlinal axis, the effect of which is traceable to a considerable distance on both sides, but having the angles of inclination reduced or flattened, as the strata recede from the central vertical vein of asphalte. No coal seam has ever been seen to occupy such a position.

The numerous distinguishing character-

istics between asphalte and coal, are detailed in the Deposition of Mr. Taylor, and in the joint Report of Messrs. Taylor and Robb.

FIG. 3. Cross section of the vein as seen at some points in Level No. VIII. It shows the opposite sides or bounding walls in the line of dislocation, and their frequent unconformability, particularly on the south-eastern side. The arrangement of the divisional planes, is neither longitudinal as in a Coal Seam, nor conformable to either wall, but occurs transversely or at right angles to them, as in asphaltic veins.

FIG. 4. A rough ground plan, or sketch of the ramifications of the vein in Level No. IV. at a point called the "Jog." It is designed chiefly to illustrate the separation of the vein; the union with and throwing off some smaller branches, and after passing around some intervening masses of slate, commonly denominated "Horses," again approaching so as to reunite with the main vein of the mine.

# APPENDIX.

## NOTE TO PAGE EIGHT.

The line of dislocation, which is here described, runs parallel with the Caledonia Mountain Range; which range is for the most composed of metamorphic, trap, porphyry, sienite, and other igneous rocks.

## NOTE TO PAGE NINETEEN.

I am enabled to render the subject of the specific gravity of Asphaltum and Petroleum more complete and instructive, by appending the following Table of results, obtained by the authorities therein named.

**Hillsborough Mine, New Brunswick.**

| OBSERVERS. | SPECIFIC GRAVITY. |
|---|---|
| Rich'd C. Taylor, 1st exp't., | 1.095 |
| Rich'd C. Taylor, 2d exp't., | 1.096 |
| Chas. E. Buck, | 1.096 |
| Professor Penny, Glasgow, | 1.097 |
| Dr. C. M. Wetherill, Phila., | 1.097 |
| Prof. Jas. Robb, M.D., | 1.106 |
| Prof. C. T. Jackson, | 1.107 |
| Rich'd C. Taylor, (lowest part of the mine worked,) | 1.091 |

**Casualidad Mine of Chapapote, Cuba.**

| | |
|---|---|
| R. C. Taylor, first specimen, | 1.142 |
| R. C. Taylor, second specimen, | 1.197 |
| R. C. Taylor, third specimen, | 1.189 |
| R. C. Taylor, fourth specimen, (porous variety), | 1.153 |

**Mine near Cardenas, Cuba.**

| | |
|---|---|
| R. C. Taylor, | 1.123 |

**Chapapote, near Matanzas, Cuba.**

| | |
|---|---|
| R. C. Taylor, | 1.160 |
| Asphalte of Coxitambo, Peru.....Bousingalt, | 1.080 |
| Albania,.....Klaproth, | 1.205 |
| the Dead Sea.....Phillips, | 1.160 |
| Do.....R. C. Taylor, | 1.148 |
| Petroleum, or Mineral Caoutchouc, of Ayers' Farm, Westmorland county, New Brunswick, R. C. Taylor, | 1.301 |
| Mineral Pitch of Trinidad, a substance intermediate between Petroleum and *compact Asphalte*, R. C. Taylor, | 1.378 |

## NOTE TO PAGE TWENTY-SEVEN.

In relation to the supposed increase in the weight of the Hillsborough asphalte, in descending, I have recently proved that such is not the case. For whereas the average specific gravity previously returned by nine investigators, gives 1.099, a mass, taken by myself in the presence of several parties, from the lowest worked part of the vein in Level 8, with a view of testing that fact, showed a specific gravity of 1.091 only.

## NOTE TO PAGE TWENTY-NINE.

In relation to this property of generating inflammable gas in mines of asphaltum, we might cite a case which appears to be somewhat applicable to the New Brunswick mine, but is on a much more superb scale. Travellers, fully entitled to credence, have described a remarkable mine of Asphaltum near the N. E. border of the Lake of Maracaibo, in Venezuela.

"The bituminous vapors arising from this mine are stated to be so easily inflamed that, during the night, phosphoric fires are continually seen, which in their effect resemble lightning. They go by the name of the '*Lantern of Maracaibo*,' because they serve for light-house and compass to the Spaniards and Indians, who, without the assistance of either, navigate the lake."

## NOTE TO PAGE THIRTY-THREE.

The following note, received from Mr. William Rice, an experienced manufacturer of Asphaltic Paint and Varnish in Philadelphia, affords conclusive evidence of the solubility of the New Brunswick Asphaltum, and its adaptation to the purposes specified.

RICHARD C. TAYLOR, ESQ.

I find that the Asphaltum is easily soluble in Coal Tar, Coal Tar Pitch, Coal Tar Naphtha, and Turpentine, at a heat of about 220 or 230 degrees of Fahrenheit. It makes a beautiful varnish, and, from all appearance, will be a substantial one. It is very much like Trinidad Asphaltum, but is much more solid, and requires a greater heat to dissolve; and in my opinion is of the same series of deposites.

It has very little earthy matter in it. I should like to contract for a quantity of it for the purpose of making it into varnish.

WM. RICE,
*Manufacturer of Marine Paint.*

Philadelphia, August 5th, 1851.

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